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Repair Instructions – Pneumatics Components

1 Patient System/Fan Heating

1.1 Replacing the Heating

- Switch the Evita off.
- Remove the flow sensor.
- Remove the patient system.
- Fold up the electronics assembly, refer to ["Repair Instructions - General, Test Equipment, Opening the Device chapter 5, Opening the Evita 4/ Evita 2 dura, page 10."](#)
- Disconnect the T-piece from the upper lip seal.
- Remove the slotted-head screws **A**, **B**, and **C**.

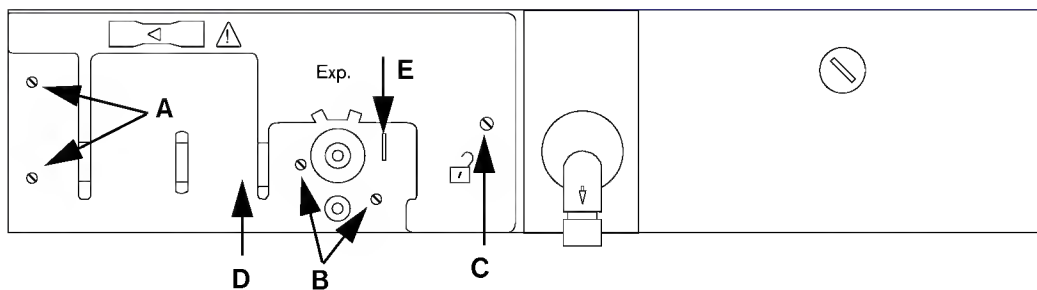


Fig. 1: Pneumatics (front view)

- Remove the heating mounting plate from the cover **D**.
- Remove the shrink tubes from the connecting cables.
- Unsolder the connecting cables from the heating.
- Remove the screws which secure the heating to the heating mounting plate and remove the heating.
- Mount the new heating by following the reverse method used for dismounting (mount the shrink tubes on the connecting cables before soldering).
- Place the spring **E** in the recess.
- Mount the cover **D**.
- Plug the T-piece onto the upper lip seal.

- Check the Evita by following the instructions in the Evita 4/Evita 2 dura Test Certificate.

1.2 Replacing the Fan

- Switch the Evita off.
- Remove the flow sensor.
- Remove the patient system.
- Fold up the electronics assembly [refer to "Repair Instructions - General, Test Equipment, Opening the Device chapter 5, Opening the Evita 4/ Evita 2 dura, page 10.](#)
- Remove the screws which secure the cover **A** and remove the cover.

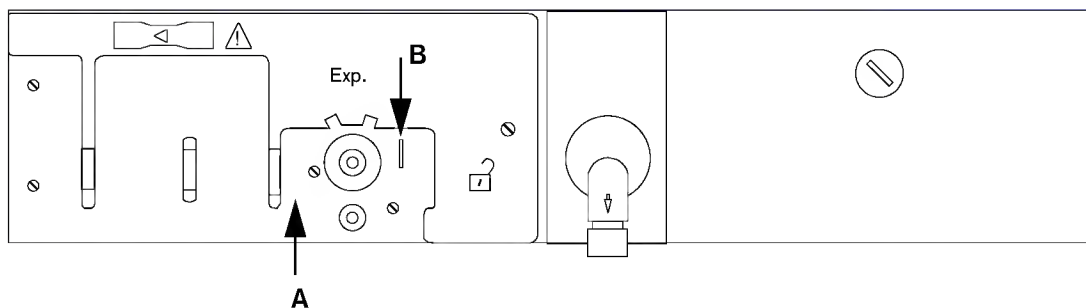


Fig. 2: Pneumatics assembly (front view)

- Pull the heating mounting plate out of the cover.
- Remove the shrink tubes from the connecting cables.
- Unsolder the connecting cables from the heating.
- Pull out the fan.
- Mount the new fan by following the reverse method used for dismounting (mount the shrink tubes on the connecting cables before soldering).
- Place the spring **B** in the recess.
- Check the Evita according to the Evita 4/Evita 2 dura Test Certificate.
- Mount the cover **A**.
- Check the hose connections (T-piece).

2 Expiratory Valve Lip Seals

2.1 Replacing the Lip Seals

- Remove the flow sensor.
- Remove the patient system.
- Fold up the electronics assembly refer to "Repair Instructions - General, Test Equipment, Opening the Device chapter 5, Opening the Evita 4/ Evita 2 dura, page 10.
- Remove the screws which secure the cover **A** and hold the cover.
- Remove the T-piece from the upper lip seal **B**.
- Remove the restrictor from the bottom lip seal **B**.
- Pull out the lip seals **B**.

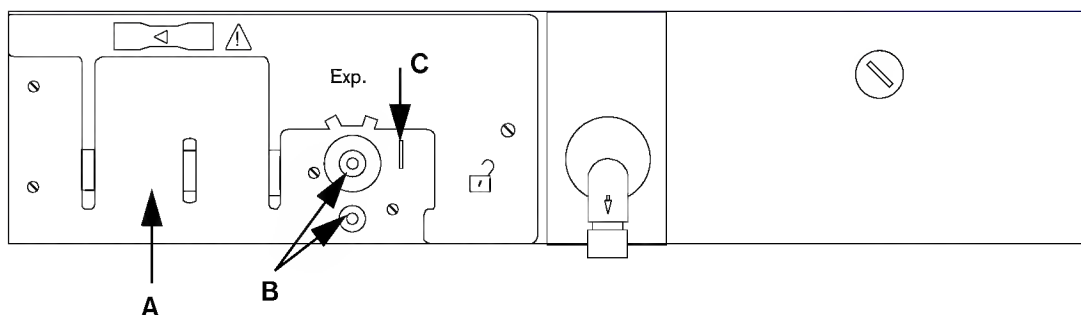


Fig. 3: Pneumatics assembly (front view)

- Mount the new lip seals.
- Place the spring **C** in the recess.
- Mount the cover **A**.
- Reconnect the hoses (T-piece).
- Check the Evita by following the instructions in the Evita 4/Evita 2 dura Test Certificate.

3 PEEP Valve

3.1 Replacing the PEEP valve

- Switch the Evita off.
- Remove the pressure connections of the Evita from the central gas supply.
- Fold up the electronics assembly refer to "Repair Instructions - General, Test Equipment, Opening the Device chapter 5, Opening the Evita 4/ Evita 2 dura, page 10.
- Disconnect the hoses from the PEEP valve.
- Remove the shrink tubes of the connecting cables at the PEEP valve.
- Unsolder the connecting cables from the PEEP valve.
- Remove the slotted-head screws **A**.

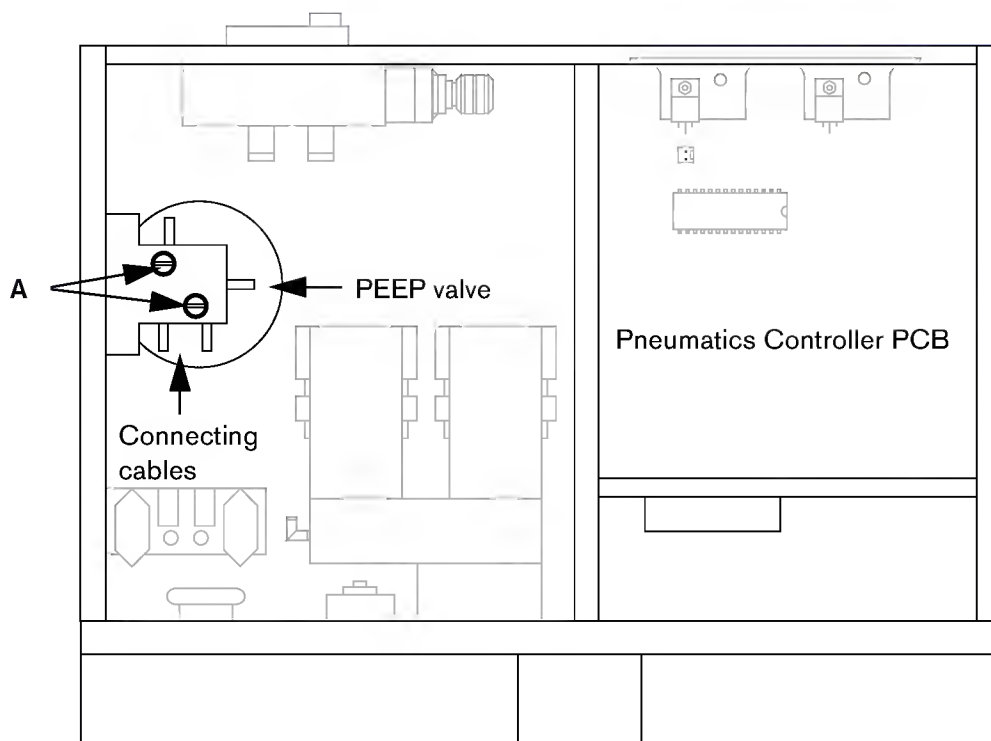


Fig. 4: Dismounting the PEEP valve

- Remove the PEEP valve.

**CAUTION**

Kinked and/or squeezed hoses adversely affect the device's function. Make sure not to kink and/or squeeze any hoses during reassembly.

- Mount the new PEEP valve by following the reverse method used for dismounting.

**IMPORTANT**

When installing the new PEEP valve make sure that the valve is electrically separated when being fixed to the fixing bracket. To do so, a complete insulating plate and 2 plastic sockets for screws A are provided.

- Calibrate the PEEP valve (see "Calibrating the PEEP valve").
- Check the Evita by following the instructions in the Evita Test Certificate.

3.2 Testing and Calibrating the PEEP/PIP Valve

Calibrate the PEEP/PIP valve if any of the following applies:

- The PEEP/PIP valve has been replaced with a new one.
- The Pneumatic Controller PCB has been replaced with a new one.
- The PEEP values are no longer correct.

3.2.1 Electrical Calibration of the PEEP/PIP Valve

This calibration work involves defined actuation of the PEEP/PIP valve and measurement of the output pressure by way of the expiratory pressure sensor. Here the offset and gain are determined at 3 and 34 mbar and stored in the EEPROM of the Pneumatics Controller PCB.

- Connect O₂ and AIR pipeline supplies.
- Disconnect ventilation hoses from inspiratory port and patient system.
- Remove flow sensor.
- Remove diaphragm **C** from the patient system.
- Screw down the diaphragm cover.
- Seal expiratory socket **D** with a rubber plug.
- Remove lip seal (flow sensor connector) **E** and seal connector.

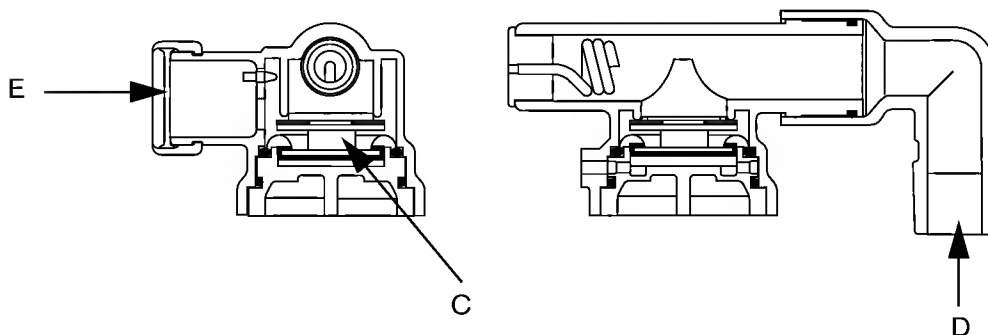


Fig. 5: Patient system

- Mount the patient system.
- Switch Evita on and set to standby mode.
- Evita 4: Select "Configuration", "System defaults", and "Service diagnosis".
Enter number combination 4 6 5 5.
Select "Pneumatics", "Valves".

- Evita 2 dura: Select "Configuration" and "Ventilation"
Enter number combination 4 6 5 5.
Select "Pneumatics", "Valves".
Reading out "Offset" and "Gain" values in Evita 2 dura only works if the optional "ServicePlus" function is available or the coding plug (RS232 adapter RXD and TXD crossed with service coding) is plugged into the COM port.
- Write down the values for "Offset" and "Gain".
- Open the "Service diagnosis" page.
- Enter the number combination 4 7 9 9 + 4 7 4 7 (starts calibration).

The calibration may take more than 1 minute.

The calibration has been completed successfully if a flow sound of approx. 0.2 seconds can be heard at the inspiratory port or if the "Offset" value or the "Gain" value has changed, or if both values have changed.

If calibration failed (flow sound of approx. 1 second audible or "Offset" and/or "Gain" unchanged), it has to be repeated. If calibration has failed several times, carry out mechanical calibration (see chapter "3.2.2") and then repeat electrical calibration.

- Restore correct condition of the patient system (make sure sealing to flow sensor is attached properly and D 5.1 is not pushed in).
- Reassemble complete unit.
- Test unit according to Test Certificate.

3.2.2 Testing and Calibrating with Mechanical Zero

First requirement:

At a supply pressure of 2 bar with a flow rate of 3.5 L/min and no power supply, the output pressure of the PEEP/PIP valve should be -1 mbar.

- Connect CS O₂ and AIR supply.
- Open the pneumatics of the Evita.
- Switch Evita on and switch to standby mode.

Prerequisite:

Pressure regulator DR1.1 (AIR) and DR1.2 (O₂) are within tolerance. If there is any doubt about this condition, perform a test as described under section 28.

- Disconnect connector X5 from the PEEP/PIP valve on the Pneumatics Controller PCB.

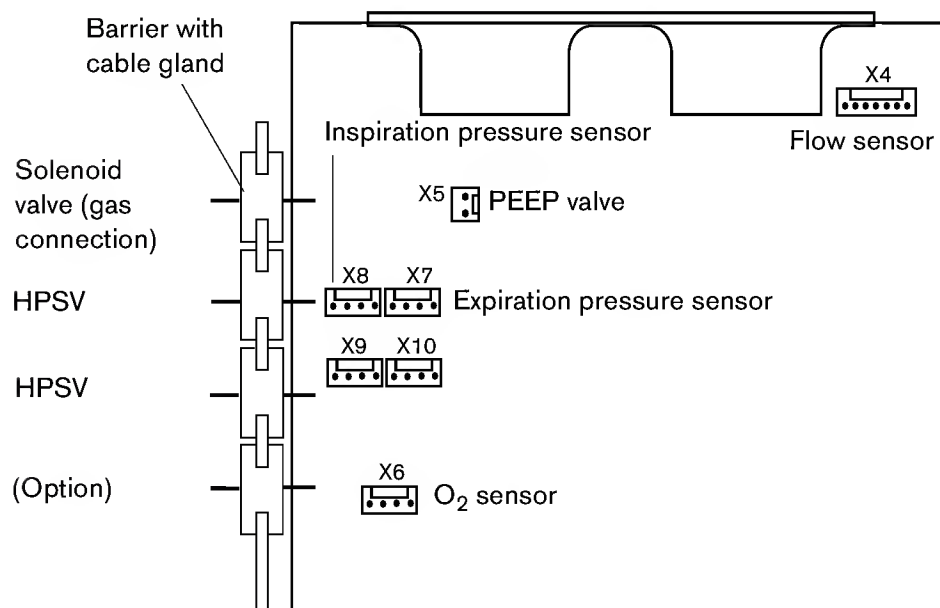


Fig. 6: Pneumatics Controller PCB connector configuration

- Measure output pressure of PEEP/PIP valve at pneumatic connection 7:

Setpoint value: -1 mbar ± 1 mbar

If the setpoint value is kept:

- Reconnect power supply of the valve on the Pneumatics Controller PCB to X5.

If the setpoint value is not kept:

- Remove left accessory rail including the side panel from the pneumatics.
- Remove the PEEP/PIP valve including the fixing bracket.
- Set zero on the bottom side of the PEEP/PIP valve to -1 ± 1 mbar using the headless screw.

In this case the valve must be operated in mounting position and must not be tilted.

- Screw out the headless screw so far until the measured value stops decreasing.
- Screw in the headless screw until the measured value is within tolerance. This is important to ensure friction locking between the drive and the diaphragm set in the PEEP/PIP valve.
- Secure headless screw with screw locking varnish.
- Attach PEEP/PIP valve with fixing bracket.
- Attach left accessory rail with side panel.
- Reconnect power supply of the valve on the Pneumatics Controller PCB to X5.

Second requirement:

When performing the electrical balance, it must be possible to control the output pressure of the PEEP/PIP valve on 3 and 34 mbar. This pressure is measured with the expiratory pressure sensor. The Offset and Gain values for the control of the power source are determined here and stored in the EEPROM on the Pneumatics Controller PCB.

- Disconnect the pneumatic connections 7 (at PEEP/PIP valve) and 8 (at pressure measuring block, i.e. exp. pressure sensor).
- Make a short-circuit between the connections 7 and 8.
- Evita 4: Press the "Configuration", "system defaults", and "service" keys.
- Evita 2 dura: Press the "Configuration" and "ventilation" keys.
- Start calibration by entering code number 4799 + 4747.

The calibration has been completed successfully if a flow sound of approx. 0.2 seconds can be heard at the inspiratory port. A flow sound of approx. 1 second means the calibration failed. In this case, it has to be repeated.

If calibration has failed several times, check if two pressure values of approx. 3 and 34 mbar can be consecutively controlled (8 times max.) by measuring the output pressure between connections 7 and 8.

Possible causes:

- – Faulty PEEP/PIP valve
- – Faulty power source on Pneumatics Controller PCB

Checking power source on Pneumatics Controller PCB:

- Measure the current through the PEEP/PIP valve on the Pneumatics Controller PCB by measuring the voltage across test points X15 with $1 \text{ mV} = 1 \text{ mA}$.
- Start calibration by entering code number 4799 + 4747. The setpoint values for the first calibration attempt are approx. 16 and 140 mV.

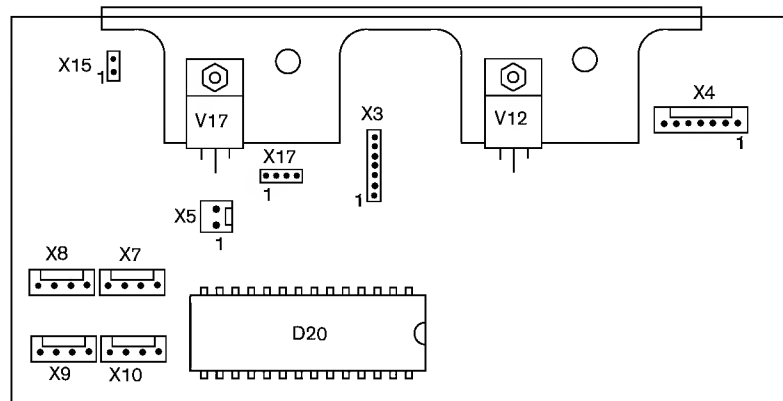


Fig. 7: Component mounting diagram of the Pneumatics Controller PCB

If the voltage values differ very much it is possible that the current control for the PEEP/PIP valve on the Pneumatics Controller PCB is faulty. If no current can be measured, the valve has not been connected.

After successful calibration:

Read out the calibration parameters "Offset" and "Gain" in the Service Mode.

- Select the "Pneumatic" and "Valves" menu.
- If the calibration has been completed successfully, the basic setting for Offset = 337 and for Gain = 89 will only be stored at random. The criterion for a positive calibration is the flow sound of 0.2 seconds.
- Restore the proper connection between connections 7 and 8 following the Pneumatics piping diagram.
- Check the Evita following the Test Certificate.

4 HPS Valve

4.1 Replacing the HPS Valve

- Switch the Evita off.
- Remove the pressure connections of the Evita from the central gas supply.
- Fold up the electronics assembly refer to "Repair Instructions - General, Test Equipment, Opening the Device chapter 5, Opening the Evita 4/ Evita 2 dura, page 10.
- Remove the cover **A**.
- Remove the inspiratory block **B**.
- Disconnect the patient system **C** refer to "Repair Instructions - Pneumatic Components chapter 1, Patient System/Fan Heating, page 3.
- Disconnect the hoses **D** from the gas connection.
- Remove the plug-in connections **E** from the HPS valve.

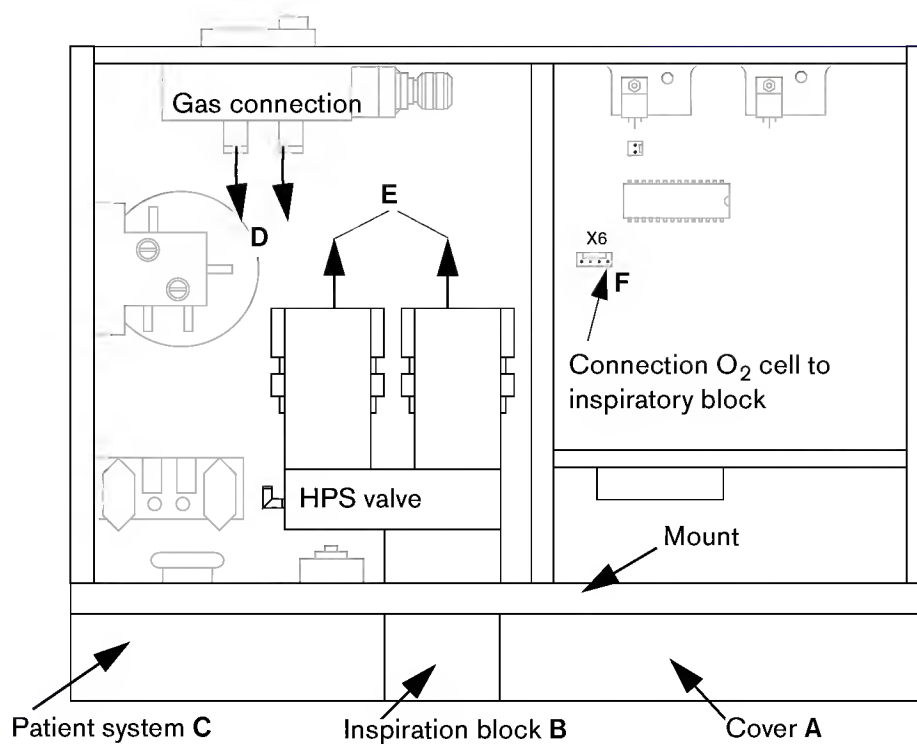


Fig. 8: Removing the HPS valve

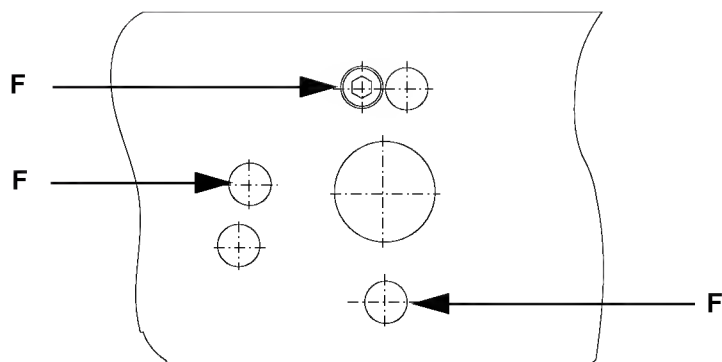


Fig. 9: Mount

- Remove the fixing screws **F** which secure the HPS valve.
- Remove the HPS valve.
- Remove the hoses from the HPS valve.
- Connect the hoses to the new HPS valve.
- Mount the new HPS valve by following the reverse method used for dismantling.



CAUTION

The HPS valve has been electrically separated from the housing. Do not mount the valve with contact to the housing (e.g. bottom plate) (class BF).



CAUTION

Kinked and/or squeezed hoses adversely affect the device's function. Make sure not to kink and/or squeeze any hoses during reassembly.

- Enter the registration number of the new HPS valve in the relevant accompanying documentation.
- Check the Evita by following the instructions in the Evita 4/Evita 2 dura Test Certificate.

4.2 Replacing the AIR Cartridge Valve

- Switch the Evita off.
- Remove the pressure connections of the Evita from the central gas supply.
- Fold up the electronics assembly refer to "Repair Instructions - General, Test Equipment, Opening the Device chapter 5, Opening the Evita 4/ Evita 2 dura, page 10.
- Remove the HPS valve (see "Replacing the HPS Valve").
- Place the HPS valve on a lint-free cloth.



CAUTION

Dirt particles may adversely affect the function of the valve. Do not allow dirt particles to enter the valve.

- Remove the fixing screws **B** from the cartridge valve.
- Remove the screws **C** from the cartridge valve cover.
- Loosen the screws **D** on the cartridge valve cover.
- Remove the cartridge valve cover.
- Pull off the connector **E** from the pressure sensor.
- Pull out the cartridge valve.

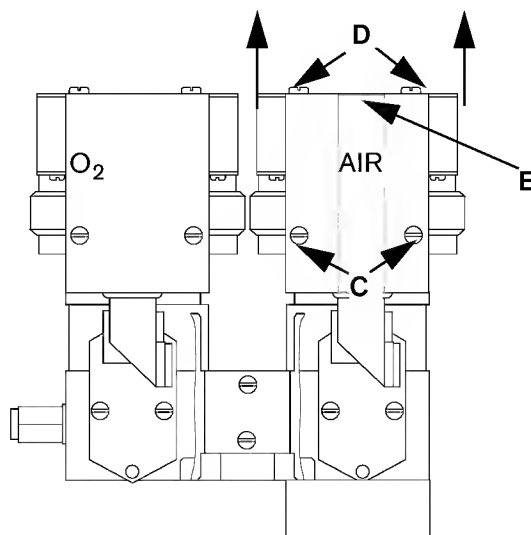


Fig. 10: HPS valve

- Enter the registration number of the new cartridge valve in the relevant accompanying papers.
- Wet the two O-rings of the new cartridge valve with distilled water.

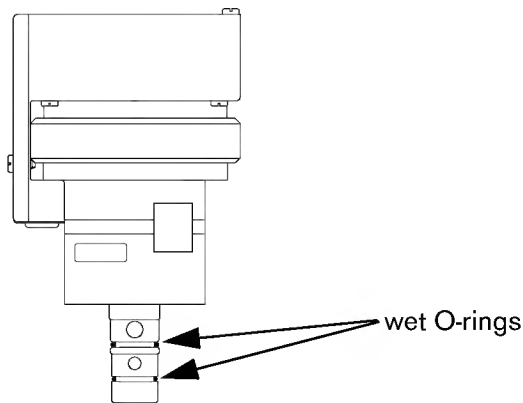


Fig. 11: Cartridge valve

- Mount the new cartridge valve by following the reverse method used for dismounting.
- Check the Evita by following the instructions in the Evita 4/Evita 2 dura Test Certificate.

4.3 Replacing the O₂ Cartridge Valve

- To replace the O₂ cartridge valve, follow the same method used for replacing the AIR cartridge valve.

4.4 Troubleshooting in Mixer

Problems with the mixer (deviations in FiO₂, VT or MV) may be caused by the following faults:

- Faulty FiO₂ or flow measurement
- Faulty supply pressure sensors for AIR or O₂
- Faulty HPSV cartridge for AIR or O₂

Faulty HPSV Controller for AIR or O₂ For troubleshooting proceed as follows:

- For deviation of FiO₂:
Perform O₂ calibration and check O₂ measurement at a setpoint value of 21 and 100 vol.%, see also test item 4.5 of Test Certificate.
- For deviation of VT or MV:
Has the sealing at the patient system to the flow sensor been properly inserted?
- When checking supply pressure sensors:
Follow test item 4.4.4 of Test Certificate.
- When checking volume control/flow measurement:
Follow test item 4.8.5 of Test Certificate.

If the test value of one gas (AIR or O₂) is not kept, interchange the two HPSV Controller PCBs. If the fault remains in the same gas type as before: the corresponding HPSV cartridge is faulty. If the fault occurs in the other gas type: faulty HPSV Controller PCB of that gas type.

4.5 Tests possible in DS mode

4.5.1 Diagnosis mode

refer to section of "Repair Instructions - Service No./ Modi, Error list" chapter 3.4.1, Diagnosis page "Valves" of "Pneumatics", page 74.

4.5.2 External DS mode using PC

refer to section of "Repair Instructions - Service No./ Modi, Error list" chapter 9.3.2, Mixer, page 129.

5 Pressure Sensors

5.1 Tests possible in DS mode

5.1.1 Diagnosis mode

refer to section of "Repair Instructions - Service No./ Modi, Error list" chapter 3.4.1, Diagnosis page "Valves" of "Pneumatics", page 74. and refer to section of "Repair Instructions - Service No./ Modi, Error list" chapter 3.4.2, Diagnosis page "Sensors" of "Pneumatics", page 77.

5.1.2 External DS mode using PC

refer to section of "Repair Instructions - Service No./ Modi, Error list" chapter 9.3.2, Mixer, page 129.

5.2 Replacing the AIR Pressure Sensor

- Switch the Evita off.
- Remove the pressure connections of the Evita from the central gas supply.
- Fold up the electronics assembly [refer to "Repair Instructions - General, Test Equipment, Opening the Device chapter 5, Opening the Evita 4/ Evita 2 dura, page 10.](#)
- Remove the cover **A**.
- Pull off the connector from the pressure sensor.
- Remove the screws **B** from the cover **C**.
- Remove the cover **C**.
- Remove the screws **D**.
- Remove the pressure sensor **E**.

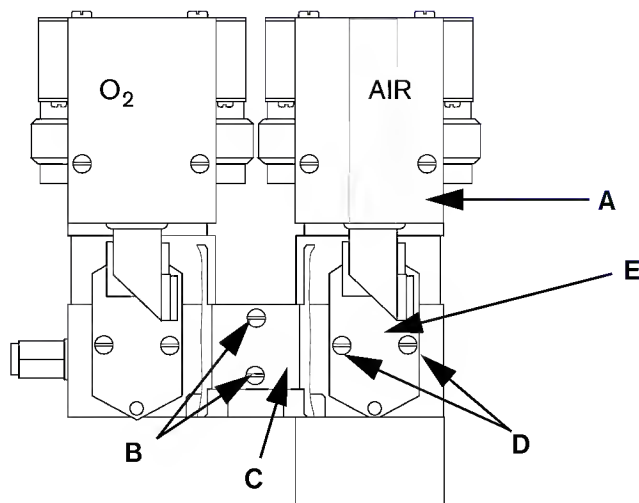


Fig. 12: Replacing the pressure sensor

- Mount the new pressure sensor by following the reverse method used for dismounting.
- Check the Evita by following the instructions in the Evita 4/Evita 2 dura Test Certificate.

5.3 Replacing the O₂ Pressure Sensor

- To replace the O₂ pressure sensor, follow the same method used for replacing the AIR pressure sensor.

5.4 Replacing the Expiratory Pressure Sensor

- Switch the Evita off.
- Fold up the electronics assembly [refer to "Repair Instructions - General, Test Equipment, Opening the Device chapter 5, Opening the Evita 4/ Evita 2 dura, page 10.](#)
- Unsolder the connecting cable from the pressure sensor.
- Remove the slotted-head screws **A** from the sensor. This action will release the frame terminal (cable eye).

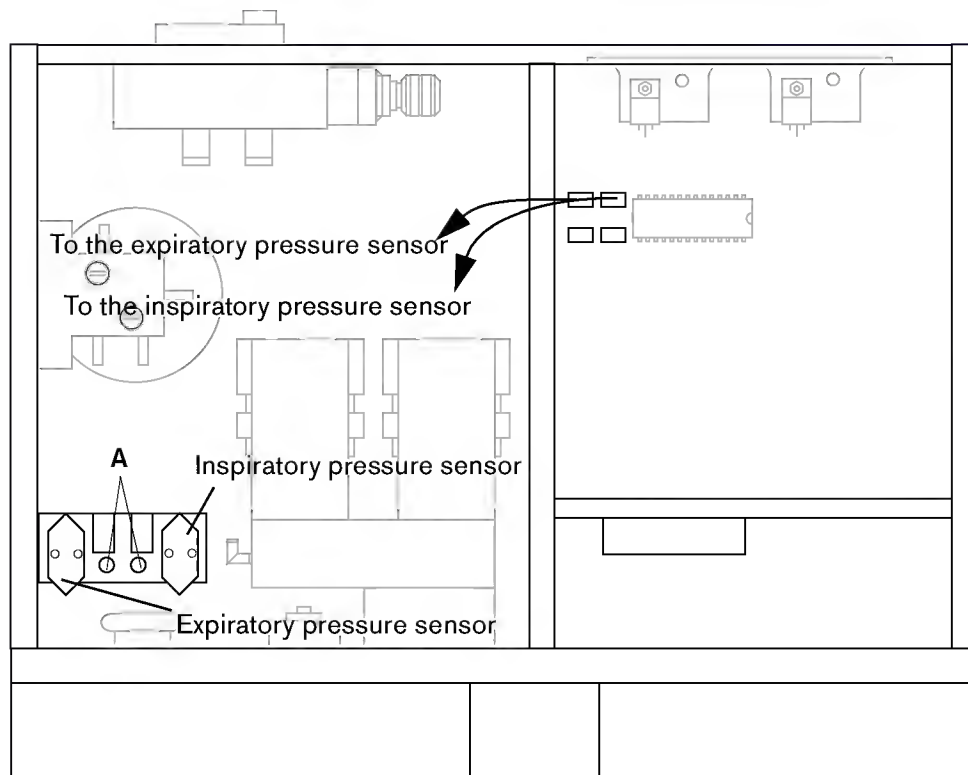


Fig. 13: Removing the pressure sensor

- Remove the pressure sensor.
- Mount the new pressure sensor by following the reverse method used for dismounting.
- Check the Evita by following the instructions in the Evita 4/Evita 2 dura Test Certificate.

5.5 Replacing the Inspiratory Pressure Sensor

- To replace the inspiratory pressure sensor, follow the same method used for replacing the expiratory pressure sensor.

6 Dräger gas connection block

6.1 Replacing the Dräger gas connection block

- Switch the Evita off.
- Remove the pressure connections of the Evita from the central gas supply.
- Remove the rear panel.
- Fold up the electronics assembly refer to "[Repair Instructions - General, Test Equipment, Opening the Device chapter 5, Opening the Evita 4/ Evita 2 dura, page 10.](#)"
- Remove the flat-head screws **A**.

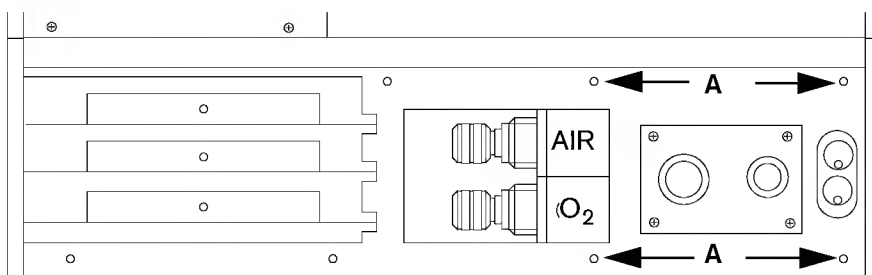


Fig. 14: Removing the Dräger gas connection block

- Disconnect the supply hoses **B** from the Dräger gas connection block.
- Remove the Dräger gas connection block from the rear panel.
- Turn the Dräger gas connection block until the pressure regulator shows upwards.

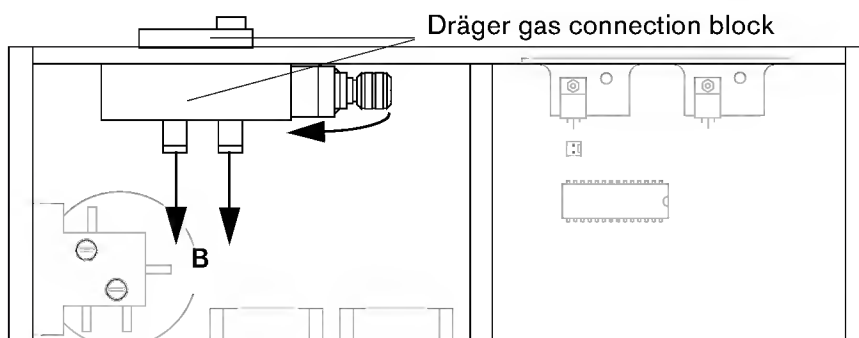


Fig. 15: Dismounting the Dräger gas connection block

- Mount the new Dräger gas connection block by following the reverse method used for dismantling.
- Check the Evita by following the instructions in the Evita 4/Evita 2 dura Test Certificate.

7 Pressure Regulator

7.1 Replacing the AIR Pressure Regulator

- Remove the slotted-head screws **C** from the AIR pressure regulator.

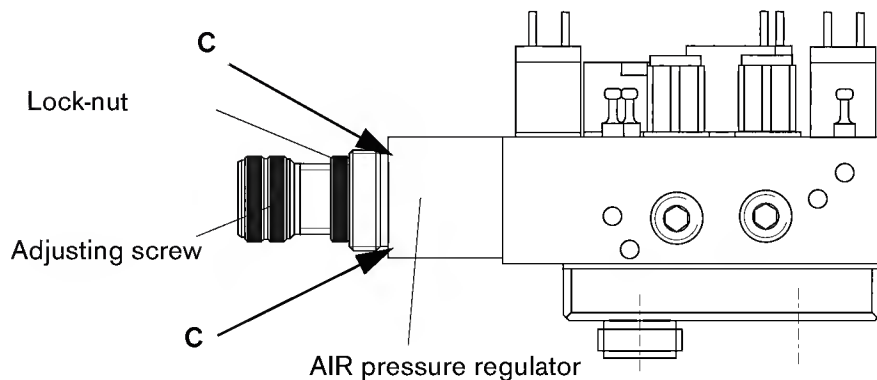


Fig. 16: Dräger Gas connection block with AIR pressure regulator

- Remove the AIR pressure regulator.
- Loosen the lock-nut of the adjusting screw on the new pressure regulator.
- Rotate the adjusting screw on the new pressure regulator three turns counterclockwise. This action closes the pressure regulator.



CAUTION

Used sealing rings may cause leaks. When replacing the pressure regulator, always replace the sealing rings with new ones.



CAUTION

An incorrectly mounted pressure regulator may damage the device. The codings (e.g. 1) at the bottom of the pressure regulator and at the gas connection block identify the inlets. The inlets must be mounted on top of each other.

- Mount the new pressure regulator by following the reverse method used for dismounting.
- Calibrate the new pressure regulator (see "Calibrating the Pressure Regulator").
- Check the Evita by following the instructions in the Evita 4/Evita 2 dura Test Certificate.

7.2 Calibrating the AIR Pressure Regulator

Calibrate the pressure regulator as follows:

- Fold up the electronics assembly refer to "Repair Instructions - General, Test Equipment, Opening the Device chapter 5, Opening the Evita 4/ Evita 2 dura, page 10.
- Prepare the following test setup.

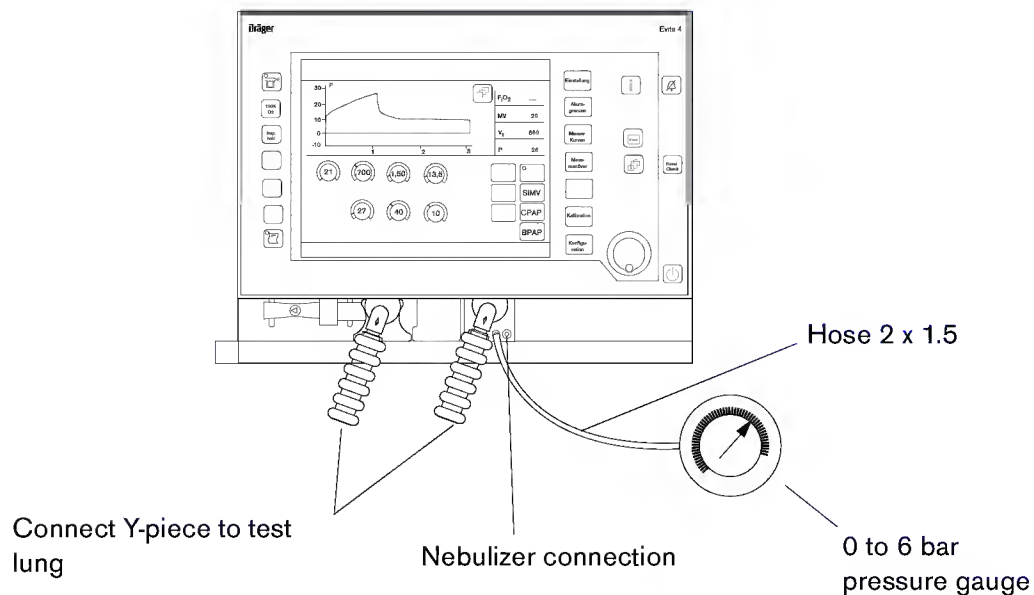


Fig. 17: Test setup

- Open the AIR gas supply only.
- Switch the Evita on.
- Select the "IPPV" mode with extended active inspiratory time and a flow of 16 L/min.
- Switch the nebulizer on.
- Set the pressure on the pressure gauge to $P = 2 \text{ bar} \pm 0.1 \text{ bar}$ (30 psi, 200 cmH₂O) by turning the adjusting screw on the pressure regulator clockwise.
- Lock the adjusting screw with the lock-nut.
- Secure the lock-nut with locking agent.
- Check the Evita by following the instructions in the Evita Test Certificate.

7.3 Replacing the O₂ Pressure Regulator

- To replace the O₂ pressure regulator, follow the same method used for replacing the AIR pressure regulator.

7.4 Calibrating the O₂ Pressure Regulator

- To calibrate the O₂ pressure regulator, follow the same method used for calibrating the AIR pressure regulator but open the O₂ gas supply only.

8 FAS Gas Connection Block

8.1 Replacing the FAS Gas Connection Block

(The replacement is to be done as described in Chapter „Replacing the Dräger Gas Connection Block“.)

9 Maintenance for the FAS Gas Connection Block

9.1 The Filter

If the filter is replaced, the O-rings should also be replaced.

9.2 Check Valves

9.2.1 Replacing the Check Valves

Check valves need only be replaced in the case of a malfunction or leakage.

- Insert a 3 mm hexagonal socket wrench into the plug-in connector.
- Press the check valve out of its receptical. While pressing, use a finger to hold the connection plate side steady.

When replacing the check valves, the following should be noted:



IMPORTANT

Do not use used check valves in the gas connection block.

- Grease the O-ring with a light coating of grease (e.g. oxigenoex).
- Place the O-ring on the check valve.

**IMPORTANT**

Do not use pointy objects to force the O-ring into the check-valve receptical.

- Carefully replace the check valve with its O-ring into the check-valve receptical.
- Check Evita according to the Test Certificate.

9.3 Pressure regulator

9.3.1 Replacing the Diaphragm and the Valve Plunger

To replace these elements, disassemble the gas connection block (see Chapter „Replacing the Dräger Gas Connection Block“).

When mounting the pressure regulator be sure to make certain that the screws are tightened mehrstufig über Kreuz with a stud torque of 100 Ncm.

After replacing the valve plunger, turn the screw plug until it touches the sealing washer, then turn it another $90^{\circ} + 20^{\circ}$.

10 Pneumatics Piping Diagram for Dräger Gas Connection Block

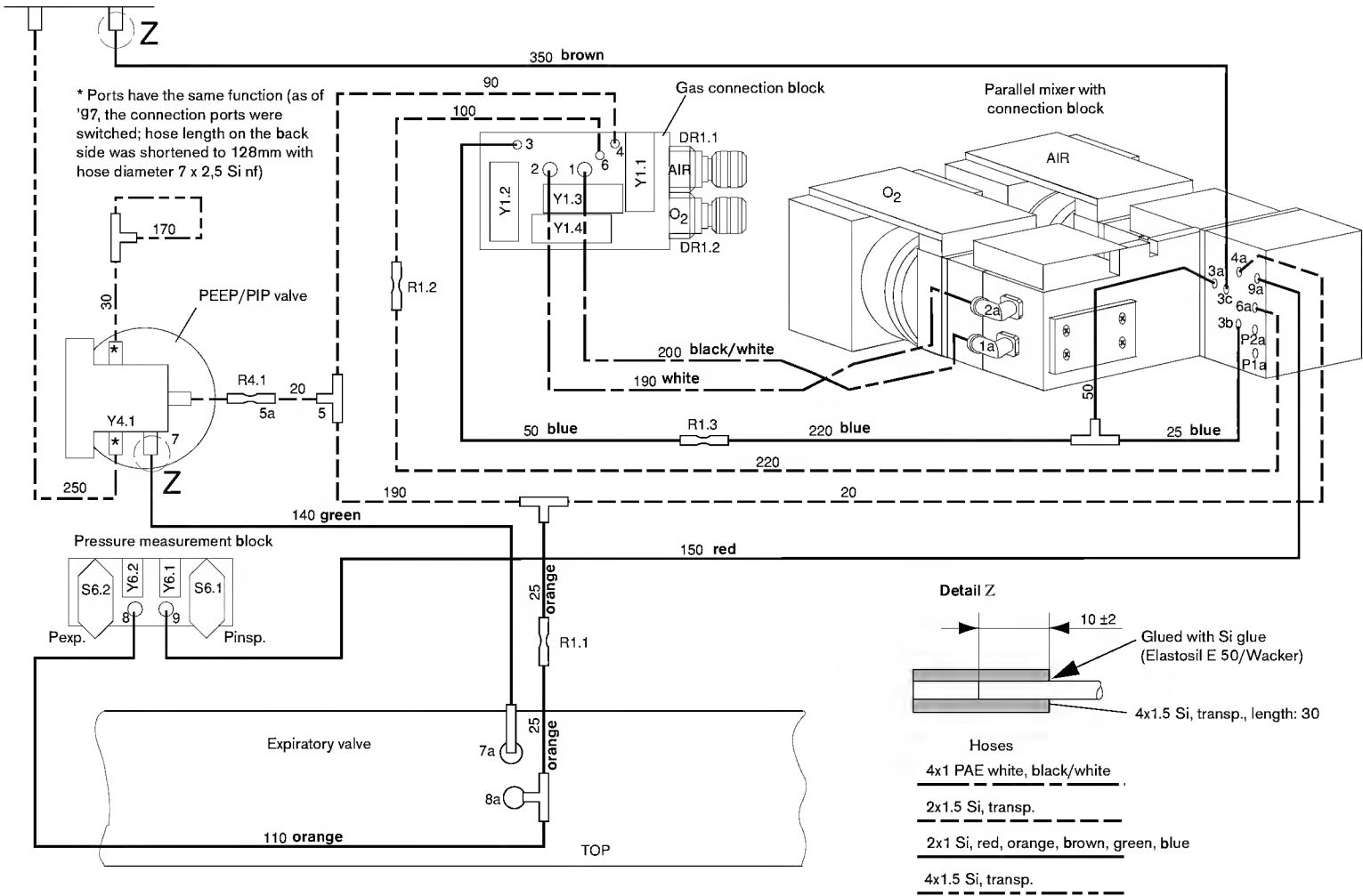


Abb. 18: Pneumatics Piping Diagram for Dräger Gas Connection Block

11 Pneumatics Piping Diagram for FAS Gas Connection Block

Fig. 19: Pneumatics Piping Diagram for FAS Gas Connection Block

